Title: To Foul or Not to Foul?

Brief Overview:

Students will determine the finances of a basketball game fund raiser. They will determine profits, percents, and probabilities. They will construct and analyze tables and graphs and make decisions and predictions based on this data.

Links to NCTM Standards:

- **Mathematics as Problem Solving**
  The students will demonstrate their ability to solve mathematical problems by designing their spinners to represent the possible outcomes of the games and by making decisions based on their calculations.

- **Mathematics as Communication**
  The students will demonstrate their ability to communicate effectively by explaining how they used data to make predictions and decisions throughout the unit.

- **Mathematics as Reasoning**
  The students will demonstrate their ability to reason by using proportions and data to make decisions both inductively and deductively, mainly using statistics and other data to draw conclusions.

- **Mathematical Connections**
  The students will demonstrate their ability to apply mathematical skills by applying the use of statistics, proportions, and percents to the area of sports and their school environment.

- **Number and Number Relationships**
  The students will demonstrate their ability to determine ratios, percentages, and number order by setting up probability ratios, calculating percents, and ordering data according to these percents.

- **Patterns and Functions**
  The students will demonstrate their ability to recognize patterns by interpreting a table of professional basketball statistics, completing tables of the statistics of their group, and constructing graphs representing percentages of profits.

- **Statistics**
  The students will demonstrate their ability to use real life statistics to determine the free throw success of each player by percents and ranking the players according to these percents.

- **Probability**
  The students will demonstrate their ability to determine the probability of possible outcomes of different situations that occur in basketball games throughout the unit.

- **Geometry**
  The students will demonstrate their ability to construct a circle graph that accurately represents the percentages of the total profit for the fund raiser.

Grade/Level:

Grades 6-8

Duration/Length:

This unit should take six 50 minute class periods, including the assessment, allowing two class periods for the first task and one class period for the remaining tasks.

Prerequisite Knowledge:

Students should have working knowledge of the following:

- Calculating percents
- Determining ratios
- Definition of probability
- Constructing circle graphs

Objectives:

Students will:

- determine the probability of specific events occurring.
- gather and interpret data.
- make accurate calculations.
- work cooperatively in groups.
- evaluate data and make valid predictions.
- accurately represent data.

Materials/Resources/Printed Materials:

- Calculators
- Protractors
- Die
- Coins
- Random number generator
- Basketballs (1 per 5 students)
- Tasks
- Assessments
- Scoring rubrics
- Class set of spinners with 4 divisions

Development/Procedures:

Days 1 & 2:
Task I: Problem Solving

Ask students about their favorite NBA teams and how they would like to have them visit their school. Present the problem to the students and clarify any questions. Allow them to work independently for the rest of the period and for the following day. Remind them to show their work.

Day 3:
Task II: Probability

Review some basketball rules with the students. Present the simulation and clarify any questions. Guide them through labeling their spinners and allow them to complete the activity.

Day 4:
Task III: Statistics

Prior to copying this task, you may wish to change the names of the players to NBA players in your town. Present the task to the students and clarify any questions. Allow them to work independently in completing the table and writing their essay. The sports section of your daily newspaper will give the statistics for the most recent game played.

Day 5:
Task IV: Enrichment

Break the class into groups of five. Present the task and explain the activity. Take them outside or to the gym to collect their data. Bring them back into the classroom to analyze their data.

Day 6:
Task V: Assessment

Assign assessment during class and/or have students finish for homework.

Performance Assessment:

Students will be assessed throughout the unit by using the scoring rubric for the following activities: Problem Solving Essay, Task #3 essay, and the final assessment essay, and by using the answer keys throughout the unit.

Extension/Follow Up:

- Students will continue their use of statistics throughout the year for other sports of interest.
- Students will apply their knowledge of probability in the Genetics unit.

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Name:
Date:
Period:

TASK 1: PROBLEM SOLVING

The Chicago Bulls are coming to your town to play your teachers in a benefit game to raise school funds. You and four classmates have been selected by the student body to organize the fund raiser so that your school makes a profit and has fun doing it.

You decide that selling tickets will be the most successful way to keep track of how many people attended the game. As an incentive to get students only - no adults to buy tickets, you announce that four tickets will be randomly selected at half-time. These four students will receive a Chicago Bulls tee-shirt and the opportunity to shoot two foul shots. An autographed Chicago Bulls basketball goes to each student who makes both foul shots. The only problem is that there are 550 students in your school and the gym holds a maximum of 375 spectators. The teachers have volunteered to chaperone the game so they need not purchase tickets for the game.

Activity 1

1. What percentage of the student population will be able to attend the game? ____ %
2. Assuming all 375 tickets are sold, what would be the probability of a student who purchased a ticket for the game, being randomly selected at half-time?_____

Activity 2

In an attempt to make the most money you have decided to sell tee-shirts and have a concession stand in addition to selling tickets. The following chart shows the initial output (the amount the school spent to purchase items), and the purchase price (the amount you actually paid) for each item sold.

ITEMS	INITIAL OUTPUT	PURCHASE PRICE
tickets	$0.00	$3.25
hot dogs		$1.50
soda		$0.75
chips	$600.00	$0.50
cookies		$0.25/pkg.
condiments		$0.00
Tee-shirts	$1,100.00	$5.00

Name:
Date:
Period:

Use the information from the chart to complete the following:

1. GREAT NEWS! The game was a sellout!! All available tickets were purchased. How much did the school profit from ticket sales? Show your calculations.

_____

2. Three hundred eighty tee-shirts were sold for the game. How much money did the school profit from the sale of tee-shirts? Show your calculations.

_____

_____

3. The concession stand sold 200 hot dogs, 400 sodas, 300 bags of chips, and 150 packages of cookies. How much money did the school profit from the sale of items from the concession stand? Show your calculations.

_____

_____

_____

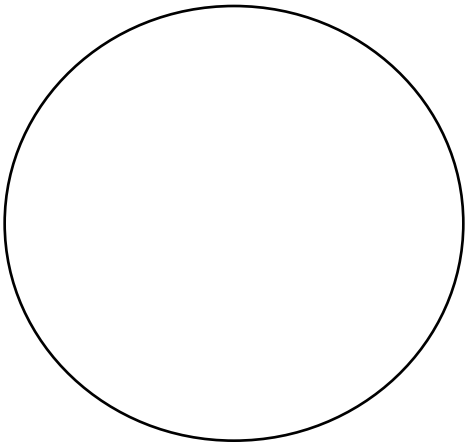
4. Enter your data from 2, 3, and 4 into the Profit column of the following chart:

ITEM	PROFIT	PERCENT PROFIT	DEGREES
Tickets Concession Stand Tee-shirts	_____ _____ _____	_____ _____ _____	_____ _____ _____
Totals			

A. Calculate the percent profit of each item to the nearest tenth and record in the chart.

Name:
Date:
Period:

B. Construct a circle graph that displays the percentage of profit from ticket sales, concession stand sales, and tee-shirt sales. Round to the nearest tenth.



1. What was the least profitable sale item for the school?

_____

2. What was the most profitable sale item for the school?

_____

Activity 3

The Chicago Bulls had such a great time that they have decided to return next year. Your committee has set a goal to raise $2,500.00 for the school next year. Based on this year's results, what changes will you make to help you meet this goal? Include data from your calculations to support your reasons for making changes.

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

TASK 1 ANSWER KEY

The Chicago Bulls are coming to your town to play your teachers in a benefit game to raise funds for your school. You and four classmates have been selected by the student body to organize the fund raiser so that your school makes a profit and has fun doing it.

You decide that selling tickets will be the most successful way to keep track of how many people attended the game. As an incentive to get students to buy tickets, you announce that four tickets will be randomly selected at half-time. These four students will receive a Chicago Bulls tee-shirt and the opportunity to shoot two foul shots. An autographed Chicago Bulls basketball goes to each student who makes both foul shots. The only problem is that there are 550 students in your school and the gym holds a maximum of 375 spectators.

Activity 1

1. What percentage of the student population will be able to attend the game? 68 %

2. Assuming all 375 tickets are sold, what would be the probability of a student who purchased a ticket for the game, being randomly selected at half-time? 4/375

Activity 2

In an attempt to make the most money you have decided to sell tee-shirts and have a concession stand in addition to selling tickets. The following chart shows the initial output (the amount the school spent to purchase items), and the purchase price (the amount you actually paid) for each item sold.

ITEMS	INITIAL OUTPUT	PURCHASE PRICE
tickets	$0.00	$3.25
hot dogs		$1.50
soda		$0.75
chips	$600.00	$0.50
cookies		$0.25/pkg.
condiments		$0.00
Tee-shirts	$1,100.00	$5.00

Use the information in the above chart to complete the following:

1. GREAT NEWS! The game was a sellout!! All available tickets were purchased. How much did the school profit from ticket sales? Show your calculations.

$ 3.25 * 375 = 1218.75

2. Three hundred eighty tee-shirts were sold for the game. How much money did the school profit from the sale of tee-shirts? Show your calculations.

380 shirts times $5.00/shirt = $1,900.00
$1,900 (actual sales) - $1,100 (costs) = $800.00 (profit)

3. The concession stand sold 200 hot dogs, 400 sodas, 300 bags of chips, and 150 packages of cookies. How much money did the school profit from the sale of items from the concession stand? Show your calculations.

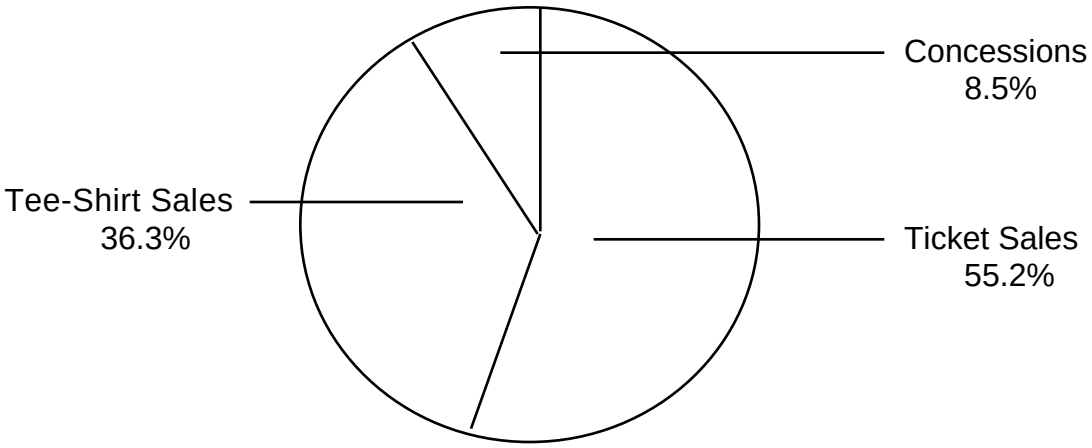
_hot dogs 200 X $1.50 = $300.00 $787.50 sales
_sodas 400 X $0.75 = $300.00 -$600.00 cost
_chips 300 X $0.50 = $150.00 187.50 profit
_cookies 150 X $0.25 = $ 37.50
_Total: $787.50 sales

4. Enter your data from from 2, 3, and 4 into the Profit column of the following chart:

ITEM	PROFIT	% PROFIT	DEGREES
Tickets	$1,218.75	55.2%	198.72
Concession Stand	$ 187.50	8.5%	30.6
Tee-shirts	$ 800.00	36.3%	130.68
Totals	$2206.25	100%	360 degrees

A. Calculate the percent profit of each item to the nearest tenth and record in the chart.

B. Construct a circle graph that displays the percentage of profit from ticket sales, concession stand sales, and tee-shirt sales. Round to the nearest tenth.



1. What was the least profitable sale item for the school?

concession stand at 8.5% profit

2. What was the most profitable sale item for the school?

ticket sales at 55.2% profit

Activity 3

The Chicago Bulls had such a great time that they have decided to return next year. Your committee has set a goal to raise $2,500.00 for the school next year. Based on this year's results, what changes will you make to help you meet this goal? Include data from your calculations to support your reasons for making changes.

Answers will vary depending on each student's decisions. They may decide to charge more for tickets due to the fact that they were all sold, to not sell food since it was the least profitable, increase food prices to make it more profitable, etc.

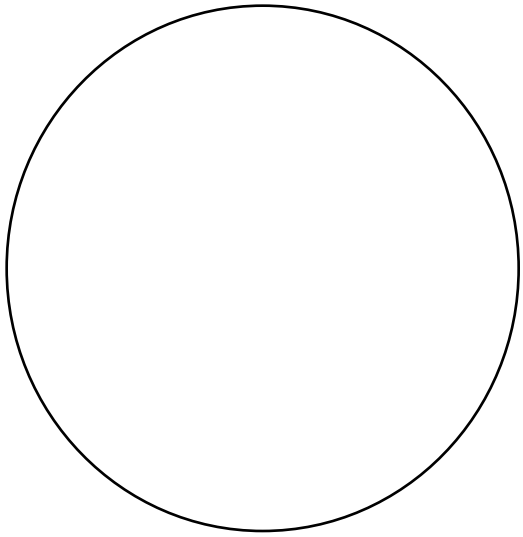
Name:

TASK II: PROBABILITY

You enjoyed watching the Chicago Bulls so much that you went to see them play the following weekend. WOW!!! What a close game!!!! In the final seconds of the game, Kukoc, a 50 % free throw shooter, was shooting and got fouled at the buzzer. The score at this time was Chicago 66 and Detroit 67. Kukoc is entitled to two free throws. In basketball, if a player is shooting and another player from the other team touches the player while he or she is shooting, a foul is called. This type of foul entitles the shooter to two free, uninterrupted shots from the foul line. Kukoc was fouled while shooting and so he goes to the free throw line and has the opportunity to win, lose or tie the game for the Bulls. If he makes both shots, the Bulls win the game by one point. If he misses both shots, the Bulls lose the game by one point. If he makes the first shot and misses the second shot, the game results in a tie and if he misses the first shot but makes the second, this is also a tie.

There are many tools that simulate probability but today you will use only a spinner.

Set up the spinner so that all possible outcomes are included.



Predict who you think will win the game.

_____

What is the probability that Kukoc <u>wins</u> the game for the Bulls?

_____

Name:

Which situation is most likely to occur?

_____

Why do you think this is so?

_____

_____

_____

_____

_____

_____

What if someone other than Kukoc got fouled while shooting, how might this change the results of the game?

_____

_____

_____

_____

_____

_____

_____

Name:

SIMULATION

Using your spinner, simulate the end of the game 30 times. Record your results in the chart below. Simulation can be done on a TI calculator with random # 1-4, no zero.

	Makes both (WIN)	Misses both (LOSE)	Makes 1st and misses 2nd (TIE)	Makes 2nd and misses 1st (TIE)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
TOTAL				

Based on your results, what was the final score of the game?

REMEMBER!!!!! THERE ARE TWO POSSIBLE WAYS TO TIE!!!!!

Chicago ☐ Detroit ☐

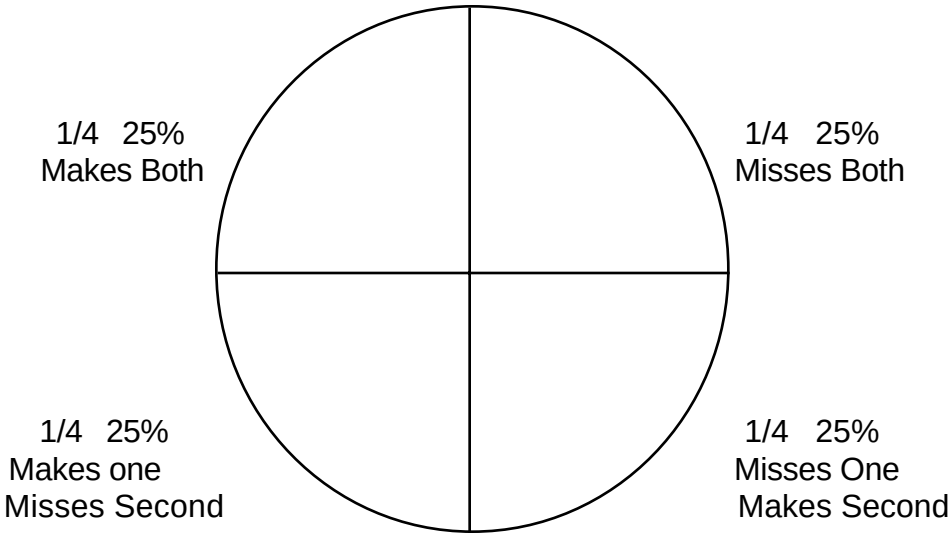
Name:

How does this score compare to your earlier prediction?

TASK II: ANSWER SHEET

You enjoyed watching the Chicago Bulls so much that you went to see them play the following weekend. WOW!!! What a close game!!!! In the final seconds of the game, Kukoc, a 50 % free throw shooter, was shooting and got fouled at the buzzer. The score at this time was Chicago 66 and Detroit 67. Kukoc is entitled to two free throws. In basketball, if a player is shooting and another player from the other team touches the player while he or she is shooting, a foul is called. This type of foul entitles the shooter to two free, uninterrupted shots from the foul line. Kukoc was fouled while shooting and so he goes to the free throw line and has the opportunity to win, lose or tie the game for the Bulls. If he makes both shots, the Bulls win the game by one point. If he misses both shots, the Bulls lose the game by one point. If he makes the first shot and misses the second shot, the game results in a tie and if he misses the first shot but makes the second, this is also a tie.

There are many tools that simulate probability but today you will use only a spinner. Set up the spinner so that all possible outcomes are included.



Predict who you think will win the game.

answers will vary

What is the probability that Kukoc wins the game for the Bulls?

1/4

Which situation is most likely to occur?

tie, because there are two possible ways

Why do you think this is so?

answers will vary. There are more ways to tie the game than to win or lose it.

What if someone other than Kukoc got fouled while shooting, how might this change the results of the game?

Answers will vary. Someone might be better than a 50% free throw shooter and this will make the result of the game different.

Simulation results and responses about comparison to earlier predictions will also vary.

Name:

TASK III: STATISTICS

Below is a table displaying the 1998 statistics of The Chicago Bulls from the Internet: (As an alternative, NCAA data could be used.)

PLAYER	FTM-A	%	RANK	3PM-A	OFF	DEF
Jordan	243-526			13-43	33	74
Pippen	122-294			18-79	49	101
Kukoc	106-218			23-61	24	57
Longley	54-120			0-0	34	56
Harper	56-122			5-19	22	55
Kehr	33-76			19-41	8	9
Rodman	39-105			1-4	99	149
Burrell	32-73			6-20	11	32
Wennington	20-38			0-0	3	11
Simpkins	6-16			0-0	4	9
Bucchler	4-11			3-5	4	7
Brown	2-12			0-0	3	6
TOTAL	717-1611			88-272	294	566

KEY:

FTM-A	Free throws made-attempted
3PM-A	3 Point shots made-attempted
OFF	Offensive rebounds
DEF	Defensive rebounds

1. Calculate the percent of free throws made for each player and fill the % column on the table. (Round answers to nearest tenth.)

Name:

2. Rank the players according to their percent of successful free throws and fill in the rank column.

3. If you were a member of a team and the score was 78-76 in your team's favor, you may not want to take a chance at an opponent making a shot. You decide to purposefully foul an opponent to improve your odds of winning. Which players would you want to foul? Which players would you not want to foul? Explain how you came to your decisions. Be sure to support your decisions using the data provided and the data you calculated.

TASK III ANSWER KEY

Below is a table displaying the 1998 statistics of The Chicago Bulls from the Internet:

PLAYER	FTM-A	%	RANK	3PM-A	OFF	DEF
Jordan	243-526	46.2	3	13-43	33	74
Pippen	122-294	41.5	8	18-79	49	101
Kukoc	106-218	48.6	2	23-61	24	57
Longley	54-120	45	5	0-0	34	56
Harper	56-122	45.9	4	5-19	22	55
Kehr	33-76	43.4	7	19-41	8	9
Rodman	39-105	37.1	10	1-4	99	149
Burrell	32-73	43.8	6	6-20	11	32
Wennington	20-38	52.6	1	0-0	3	11
Simpkins	6-16	37.5	9	0-0	4	9
Bucchler	4-11	36.4	11	3-5	4	7
Brown	2-12	16.7	12	0-0	3	6
TOTAL	717-1611			88-272	294	566

KEY:

FTM-AFree throws made-attempted
3PM-A3 Point shots made-attempted
OFF Offensive rebounds
DEF Defensive rebounds

1. Calculate the percent of free throws made for each player and fill the % column on the table. (Round answers to nearest tenth.)

2. Rank the players according to their percent of successful free throws and fill in the rank column.

3. If you were a member of a team and the score was 78-76 in your team's favor, you may not want to take a chance at an opponent making a shot. You decide to purposefully foul an opponent to improve your odds of winning. Which players would you want to foul? Which players would you not want to foul? Explain how you came to your decisions. Be sure to support your decisions using the data provided and the data you calculated.

Answers will vary, depending on whether students choose data according to the player's rank, the number of attempted free throws, etc.

Name:
Date:
Period:

TASK IV: ENRICHMENT

Now is your opportunity to show off your basketball skills. You are going to be in groups of 5 and you will each shoot 10 free throws.

RULES:
- Do not cross the line.
- Shoot all 10 of your shots before the next person shoots.
- You each get 3 practice shots before starting.
- Your group members will help you keep your score.

HINT: You will do better if you do the exact same warm - up before each shot. For example, walk to the line, dribble two times and then shoot.

You will record the number of shots you make out of 10.
After each member of your team has a turn to shoot your 10 free throws, you will calculate the percentages made for each group member.
Finally, you will decide who of your group you would hope to be fouled in a game situation and use you data and statistics to explain why.

NAME:

NUMBER OF SHOTS MADE OUT OF 10:

PERCENTAGE OF SHOTS MADE:

IF YOU WERE ALL A MEMBER OF THE SAME TEAM, AND THE GAME WAS REALLY CLOSE, WHO WOULD YOU WANT TO BE FOULED WHILE SHOOTING?

WHY?

_____

_____

_____

_____

_____

_____

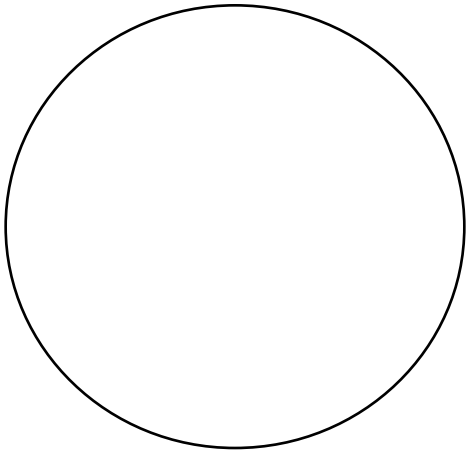
_____

Name:
Date:
Period:

TASK: V ASSESSMENT

There is another situation that often occurs in the game of basketball. Sometimes a player is dribbling, holding or passing the basketball, and he or she is touched by a member of the other team. This also results in a foul being called. If the team that receives the foul, already has 6 previous fouls, and a seventh foul is committed, the person that was fouled gets to shoot a “one - and - one” . This shot also takes place on the foul line. This is different from a two shot foul because this time you are not guaranteed two automatic shots. This time, you MUST make the first shot to get to the second shot. You have a 50% chance of making the first shot. If you are successful on the first shot then you once again have a 50% chance of making the second shot. HOWEVER, you do not get the second shot until you find out if you have made the first shot. If you miss the first shot, the game is over and you have lost the game. If you make the first shot you have at least tied or won the game for your team. The result will depend on the success of your second shot. The type of foul that the other team gets determines the type of foul shot your team receives. Had Kukoc, a 50% free throw shooter, shot a one (one - and - one) shot instead of a two shot foul the game might have had different results.

Using the following spinner, identify the possible outcomes of a one - and - one shot.



How is this different from the two shot foul shot?

_____

_____

Name:
Date:
Period:

The score is
Chicago 66 and Detroit 67

Suppose Kukoc had a one - and - one shot instead of a two shot foul. What is the new probability that Kukoc wins the game for the Bulls?

_____

What in this situation is most likely to occur?

_____

Why do you think so?

_____

_____

_____

_____

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_____

_____

_____

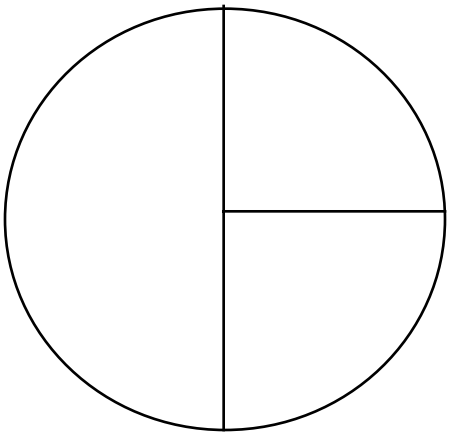
Name:
Date:
Period:

Imagine you are Kukoc and you have the opportunity to win the NBA series for the Bulls. All these thoughts are going through your mind. You are thinking about how many tennis shoe companies will want you to be their advertisers. You are envisioning your picture on the cover of the Wheaties cereal box. You are deciding on what type of car you will buy with all the money you will receive for winning the game. You are so nervous. Your palms have become sweaty. You know the team is counting on you to win the game for them and you know that the other team is going to intentionally foul you so that you have to shoot a foul shot. Which type of foul shot (two shot, or one - and - one) would give you the best chance of winning the game for your team? Don't forget to thoroughly justify you answer using all the information you have gathered from this task.

TASK V ANSWER KEY

There is another situation that often occurs in the game of basketball. Sometimes a player is dribbling, holding or passing the basketball, and he or she is touched by a member of the other team. This also results in a foul being called. If the team that receives the foul, already has 6 previous fouls and a seventh foul is committed, the person that was fouled gets to shoot a “one - and - one” . This shot also takes place on the foul line. This is different from a two shot foul because this time you are not guaranteed two automatic shots. This time, you MUST make the first shot to get to the second shot. You have a 50% chance of making the first shot. If you are successful on the first shot then you once again have a 50% chance of making the second shot. HOWEVER, you do not get the second shot until you find out if you have made the first shot. If you miss the first shot, the game is over and you have lost the game. If you make the first shot you have at least tied or won the game for your team. The result will depend on the success of your second shot. The type of foul that the other team gets determines the type of foul shot your team receives. Had Kukoc, a 50% free throw shooter, shot a one (one - and - one shot) instead of a two shot foul the game might have had different results.

Using the following spinner, identify the possible outcomes of a one - and - one shot.



Lose
Miss the first shot

Tie
Make the first, miss the second shot

Win
Make the first, make the second shot

How is this different from the two shot foul shot?

Different because with a two shot foul you have a 50% chance of at least tying the game.

With a one and one foul you have a 50% chance of losing the game if you do not make the first shot

The score is
Chicago 66 and Detroit 67

Suppose Kukoc had a one - and - one shot instead of a two shot foul. What is the new probability that Kukoc wins the game for the Bulls?

1/4

What in this situation is most likely to occur?

They are more likely to lose the game.

Why do you think so?

There is a 50% chance of making and also missing the first shot. Because of this they have a greater chance of losing the game. They could lose it on the first shot where as in a two shot foul they at least have another chance to tie the game.

Imagine you are Kukoc and you have the opportunity to win the NBA series for the Bulls. All these thoughts are going through your mind. You are thinking about how many tennis shoe companies will want you to be their advertisers. You are envisioning your picture on the cover of the Wheaties cereal box. You are deciding on what type of car you will buy with all the money you will receive for winning the game. You are so nervous. Your palms have become sweaty. You know the team is counting on you to win the game for them and you know that the other team is going to intentionally foul you so that you have to shoot a foul shot. Which type of foul shot (two shot, or one - and - one) would give you the best chance of winning the game for your team? Don't forget to thoroughly justify you answer using all the information you have gathered from this task.

The answers will vary depending on the successfulness of the task.

Credit should be given to any student who correctly answers the question and who justifies their answers using the task.

The answer should reflect the fact that with a one and one shot you have a 50% chance of losing the game immediately but with a two shot foul shot you have a 50% chance of at least tying the game for the team.

SCORING RUBRIC

Task:

3

- Written response is complete, clearly developed, and contains accurate and valid support using the data and number concepts
- Written response communicates effectively to the audience

2

- Written response is fairly complete and clearly developed, and contains accurate and valid support using the data and number concepts
- Written response communicates fairly effectively to the audience

1

- Written response is incomplete and partially developed, and not all data is accurate
- Written response attempts to communicate effectively to the audience

0

- Totally Blank or Unreadable